included in Table 9-8. Since none of the proposed permit limits are below the analytical method detection limits (MDLs), no further evaluation of the permit limits is required to evaluate the compliance level. Based upon the information provided in Volumes I and II and the process described in this report, Amoco does not anticipate changes to the quality of the Outfall 001 treated effluent nor is it seeking to increase the amount of constituents in the effluent.

## TABLE 9-1. SUMMARY OF EXISTING MONTHLY AVERAGE PERMIT LIMITS, HISTORICAL PERFORMANCE, AND BPT/BAT/BCT LIMITS (d)

| PARAMETER | CONC. UNITS | EXISTING PERMIT LIMITS (a) | | HISTORICAL PERFORMANCE (b) | | BPT/BAT/BCT LIMITS (c) | |
|---|---|---|---|---|---|---|---|
| | | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) |
| METALS | | | | | | | |
| Total Chromium | mg/L | Report | 23.9 | 0.015 | 2.4 | | 92.9 |
| Hex. Chromium | mg/L | Report | 2.01 | 0.003 | 0.58 | | 6.39 |
| CONVENTIONALS | | | | | | | |
| Ammonia as N | mg/L | Report | 1,030 | 0.6 | 68.3 | | 2,206 |
| Phenolics (4AAP) | µg/L | Report | 20.33 | 0.016 | 3.11 | | 37.7 |
| TBOD5 | mg/L | Report | 4,161 | 5.8 | 721 | | 5,283 |
| TSS | mg/L | Report | 3,646 | 24.6 | 2,059 | | 4,645 |
| COD | mg/L | Report | 30,323 | 67.2 | 7,973 | | 38,320 |
| Oil & Grease | mg/L | Report | 1,368 | 3.9 | 463 | | 1,742 |
| Sulfide | mg/L | Report | 23.1 | 0.068 | 6.7 | | 30.8 |
| Fecal Coliform | col./100mL | 200 | | (d) | | | |

NOTES
(a) Permit effective from April 1, 1990 to February 28, 1995.
(b) Maximum value from the past 3 years of Discharge Monitoring Report data.
(c) In accordance with 40 CFR Part 419 Subpart D.
(d) Shading indicates not applicable.

BPT – Best Practicable Control Technology Currently Available
BAT – Best Available Technology Economically Achievable
BCT – Best Conventional Pollutant Control Technology



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## TABLE 9–2. SUMMARY OF EXISTING DAILY MAXIMUM PERMIT LIMITS, HISTORICAL PERFORMANCE, AND BPT/BAT/BCT PERMIT LIMITS (f)

| PARAMETER | CONC. UNITS | EXISTING PERMIT LIMITS (a) | | HISTORICAL PERFORMANCE (b) | | BPT/BAT/BCT PERMIT LIMITS (c) | |
|---|---|---|---|---|---|---|---|
| | | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) |
| METALS | | | | | | | |
| Total Chromium | µg/L | Report | 68.53 | 0.03 | 5.3 | | 158.5 |
| Hex. Chromium | µg/L | Report | 4.48 | 0.007 | 1.23 | | 13.93 |
| CONVENTIONALS | | | | | | | |
| Ammonia as N | mg/L | Report | 2,060 | 13.0 | 1,446 | | 4,819 |
| Chlorine (T.R.) | mg/L | 0.05 | | (d) | | | |
| Phenolics (4AAP) | µg/L | Report | 73.01 | 0.09 | 17.9 | | 77.2 |
| TBOD5 | mg/L | Report | 8,164 | 29 | 3,580 | | 10,393 |
| TSS | mg/L | Report | 5,694 | 71 | 4,904 (e) | | 7,258 |
| COD | mg/L | Report | 58,427 | 135 | 18,515 | | 73,736 |
| Oil & Grease | mg/L | Report | 2,600 | 12.8 | 1,594 | | 3,309 |
| Sulfide | mg/L | Report | 51.4 | 0.12 | 14.3 | | 68.5 |
| Fecal Coliform | col./100ml | 400 | | (d) | | | |
| pH | s.u. | 6.5 – 9.0 | | 6.7 – 8.1 | | | |

NOTES:
(a) Permit effective from April 1, 1990 to February 28, 1995.
(b) Maximum value for the past 3 years of Discharge Monitoring Report data.
(c) In accordance with 40 CFR Part 419 Subpart D.
(d) No data collected since sanitary wastewater not discharged to WWTP.
(e) Highest value (10,553 lbs/day on 08/31/93) is not included in the data set since it occurred due to successive rainfall events related to the extreme midwest flooding of 1993.
(f) Shading indicates not applicable.

BPT – Best Practicable Control Technology Currently Available
BAT – Best Available Technology Economically Achievable
BCT – Best Conventional Pollutant Control Technology



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## TABLE 9–3. SUMMARY OF PROPOSED MONTHLY AVERAGE PERMIT LIMITS (g)

| PARAMETER | CONC. UNITS | EXISTING PERMIT LIMITS (a) | | WQBEL PERMIT LIMITS (b) | | PROPOSED PERMIT LIMIT (c) | |
|---|---|---|---|---|---|---|---|
| | | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) |
| METALS | | | | | | | |
| Total Chromium | mg/L | Report | 23.9 | Not Needed (d) | Not Needed (d) | Report | 23.9 |
| Hex. Chromium | mg/L | Report | 2.01 | Not Needed (d) | Not Needed (d) | Report | 2.01 |
| CONVENTIONALS | | | | | | | |
| Ammonia as N | mg/L | Report | 1,030 | 12.1 | 2,275 | 12.1 | 1,030 |
| Total Phosphorus | µg/L | | | 710 | 133 | 710 | 133 |
| Phenolics (4AAP) | µg/L | Report | 20.33 | Not Needed (d) | Not Needed (d) | Report | 20.33 |
| Chlorides | mg/L | | | 575 | 107,892 | 575 | 107,892 |
| Sulfates | mg/L | | | 667 | 125,247 | 667 | 125,247 |
| TDS | mg/L | | | 4,173 | 783,068 | 4,173 | 783,068 |
| TBOD5 | mg/L | Report | 4,161 | | | Report | 4,161 |
| TSS | mg/L | Report | 3,646 | | | Report | 3,646 |
| COD | mg/L | Report | 30,323 | | | Report | 30,323 |
| Oil & Grease | mg/L | Report | 1,368 | | | Report | 1,368 |
| Sulfide | mg/L | Report | 23.1 | | | Report | 23.1 |
| Fecal Coliform | col./100mL | 200 | | | | 200 (f) | No Limit (e) |

NOTES
(a) Permit effective from April 1, 1990 to February 28, 1995.
(b) In accordance with Technical Release OWM–1 Procedure for Developing Water Quality–Based NPDES Permit Limits for Toxic Pollutants, IDEM.
(c) The most representative and valid limit is the draft permit limit.
(d) Based upon USEPA procedures for determining whether a WQBEL is needed.
(e) No limit required by any method used for developing permit limits.
(f) Only required when sanitary wastewater discharges to the WWTP.
(g) Shading indicates not applicable.

WQBEL – Water Quality–Based Effluent Limit

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## TABLE 9–4. SUMMARY OF PROPOSED DAILY MAXIMUM PERMIT LIMITS (g)

| PARAMETER | CONC. UNITS | EXISTING PERMIT LIMITS (a) | | WQBEL PERMIT LIMITS (b) | | PROPOSED PERMIT LIMIT (c) | |
|---|---|---|---|---|---|---|---|
| | | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) | CONC. | LOAD (lb/d) |
| METALS | | | | | | | |
| Total Chromium | µg/L | Report | 68.53 | Not Needed (d) | Not Needed (d) | Not Needed (d) | 68.53 |
| Hex. Chromium | µg/L | Report | 4.48 | Not Needed (d) | Not Needed (d) | Not Needed (d) | 4.48 |
| CONVENTIONALS | | | | | | | |
| Ammonia as N | mg/L | Report | 2,060 | 28.1 | 5,281 | 28.1 | 2,060 |
| Chlorine (T.R.) | mg/L | 0.05 | | Not Needed (d) | Not Needed (d) | 0.05 (f) | Not Needed (e) |
| Total Phosphorus | µg/L | | | 1,647 | 309 | 1,647 | 309 |
| Phenolics (4AAP) | µg/L | Report | 73.01 | Not Needed (d) | Not Needed (d) | Report | 73.01 |
| Chlorides | mg/L | | | 1,335 | 250,476 | 1,335 | 250,476 |
| Sulfates | mg/L | | | 1,550 | 290,766 | 1,550 | 290,766 |
| TDS | mg/L | | | 9,688 | 1,817,916 | 9,688 | 1,817,916 |
| TBOD5 | mg/L | Report | 8,164 | | | Report | 8,164 |
| TSS | mg/L | Report | 5,694 | | | Report | 5,694 |
| COD | mg/L | Report | 58,427 | | | Report | 58,427 |
| Oil & Grease | mg/L | Report | 2,600 | | | Report | 2,600 |
| Sulfide | mg/L | Report | 51.4 | | | Report | 51.4 |
| Fecal Coliform | col./100ml | 400 | | | | 400 (f) | No Limit (e) |
| pH | s.u. | 6.5 – 9.0 | | | | 6.5 – 9.0 | No Limit (e) |

NOTES:
(a) Permit effective from April 1, 1990 to February 28, 1995.
(b) In accordance with Technical Release OWM–1 Procedure for Developing Water Quality–Based NPDES Permit Limits for Toxic Pollutants, IDEM.
(c) The most representative and valid limit is the draft permit limit.
(d) Based upon USEPA procedures for determining whether a WQBEL is needed.
(e) No limit required by any method used for developing permit limits.
(f) Only required when sanitary wastewater discharges to the WWTP.
(g) Shading indicates not applicable.

WQBEL – Water Quality–Based Effluent Limit

AUG 23 1994

# VOLUME III

# NPDES PERMIT RENEWAL APPLICATION

# NPDES PERMIT NO. IN 0000108

# PERMIT LIMITS DERIVATION REPORT

Prepared for:

**AMOCO OIL COMPANY**
**Whiting Refinery, Indiana**

Prepared by:

The ADVENT Group, Inc.

August 1994

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## FOREWORD

This report is Volume III of the Amoco Oil Company, Whiting Refinery, application to renew NPDES Permit Number IN 0000108.

This report presents the derivation of proposed limits for the renewed NPDES permit for the treated process wastewater discharged from Outfall 001. The various components of the NPDES permitting process are presented in the context of the effluent characterization data in Volume I, and the Mixing Zone Demonstration report in Volume II of this application. The permit limits proposed in this report are developed based upon an analysis of existing permit limits, technology-based permit limits, and water quality-based effluent limits (WQBELs). For each parameter, the most representative and valid permit limit is proposed as a permit limit.

The introduction in Section 1, is followed, in Section 2, by an overview of how draft permit limits are developed. Section 3 presents the existing permit limits. Section 4 presents a summary of the historical performance of the Outfall 001 effluent over the past three years. Section 5 presents the development of technology-based permit limits. Section 6 presents the projected effluent quality and how it is used to determine the need for the water quality-based effluent limits (WQBELs). The WQBELs are calculated in Section 7. Section 8 discusses the effect of total to dissolved metals ratio data on the permit limits for metals. Finally, Section 9 combines the different methods of developing permit limits into one set of proposed permit limits.

# SECTION 1

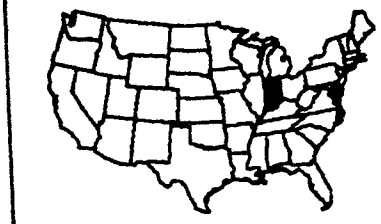
# INTRODUCTION

As part of the permit renewal application, Amoco Oil Company, Whiting Refinery, (Amoco) is submitting this report to provide an easily understood and scientifically supportable description of the derivation of proposed permit limits for Outfall 001. This report presents the data needed to derive permit limits and the IDEM and USEPA methods by which that process is accomplished, outlines the different permitting components that may be used to derive permit limits, and describes how they are evaluated to develop draft permit limits.

## FACILITY DESCRIPTION

The Amoco Whiting Refinery occupies approximately 1,700 acres near the southern end of Lake Michigan as presented in Figures 1-1 and 1-2. The petroleum refinery includes processes such as distillation, catalytic reforming, hydrodesulfurization, catalytic cracking, alkylation, coking, treating, extraction, dewaxing, grease and lube oil production, asphalt production, sulfur recovery and power generation. The refining throughput varies with product demand and other market considerations, but its capacity is well over 400,000 barrels of crude oil per day. Amoco produces a variety of products including jet fuel, gasoline, diesel fuel, heating fuel, lubricating oils, asphalt, coke and waxes. The refinery generates process waters which are continuously treated onsite at an advanced biological wastewater treatment plant (WWTP) as shown schematically in Figure 1-3. Stormwater run-off and recovered groundwater from refinery areas are also treated at the WWTP. The treated effluent is then discharged to Lake Michigan through a National Pollutant Discharge Elimination System (NPDES) permitted outfall (Outfall 001). The refinery withdraws Lake Michigan waters for use in process units and for a once-through cooling process. Outfall 001 is regulated by NPDES

AMOCO OIL COMPANY – WHITING REFINERY
WHITING, INDIANA



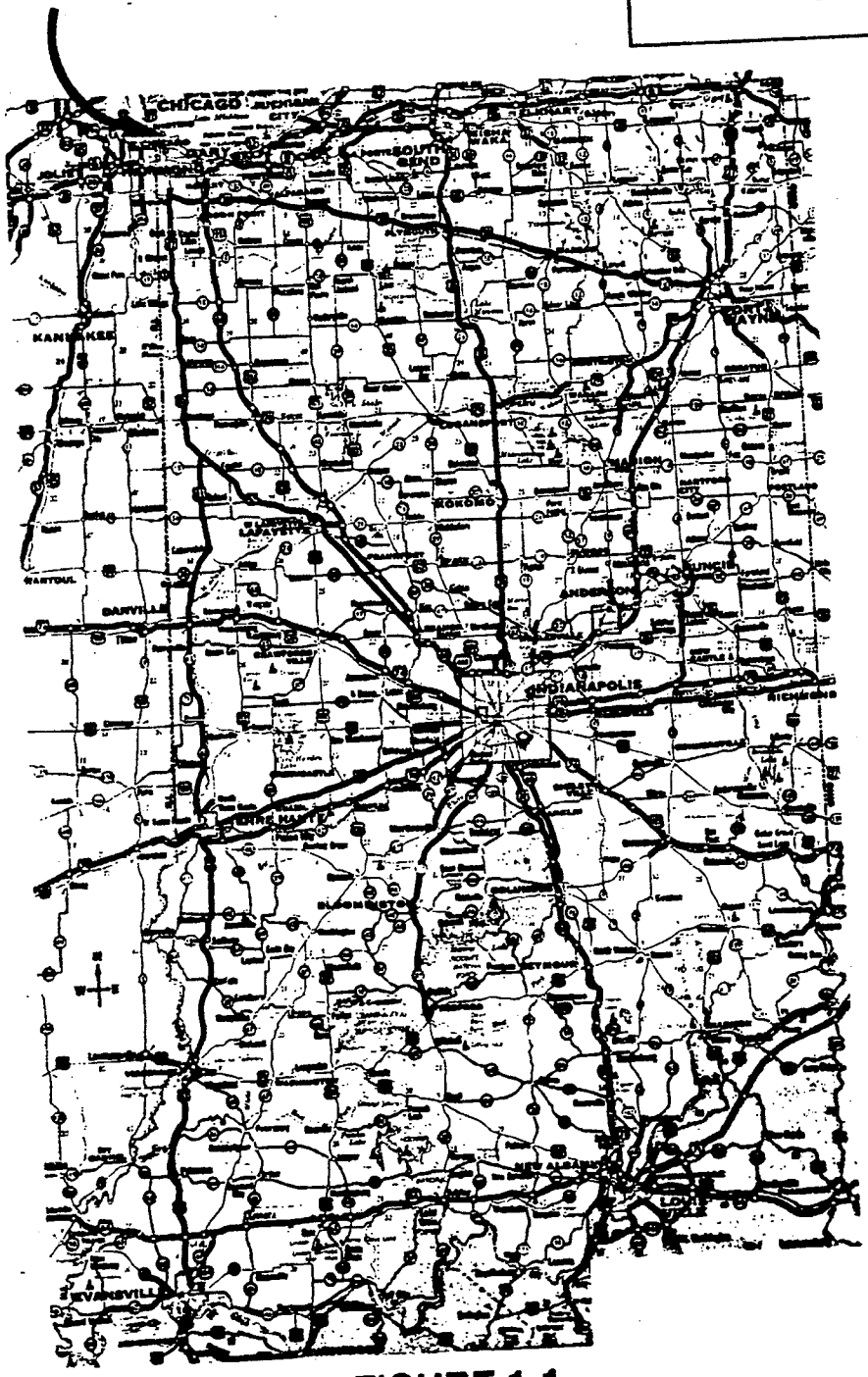
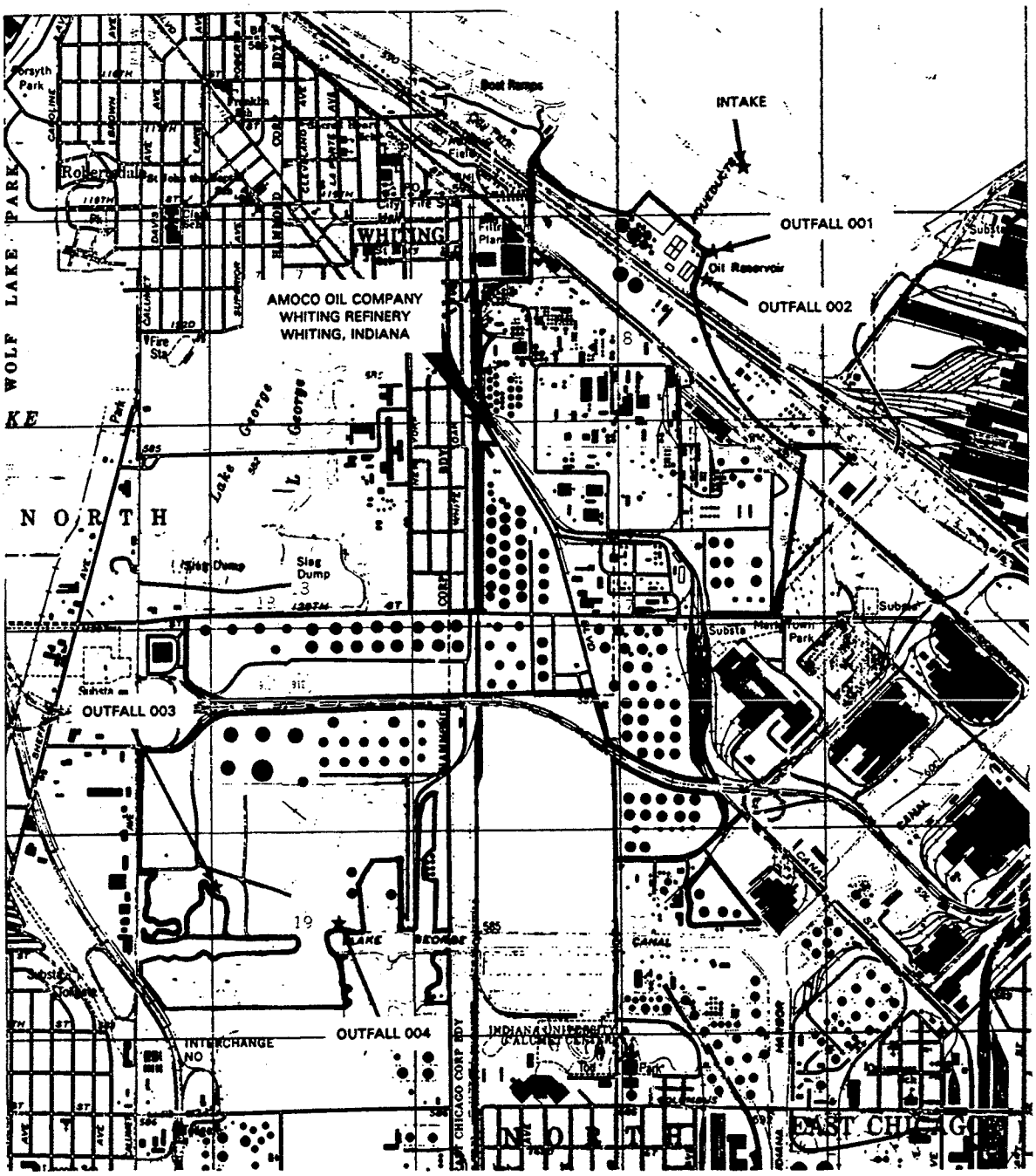


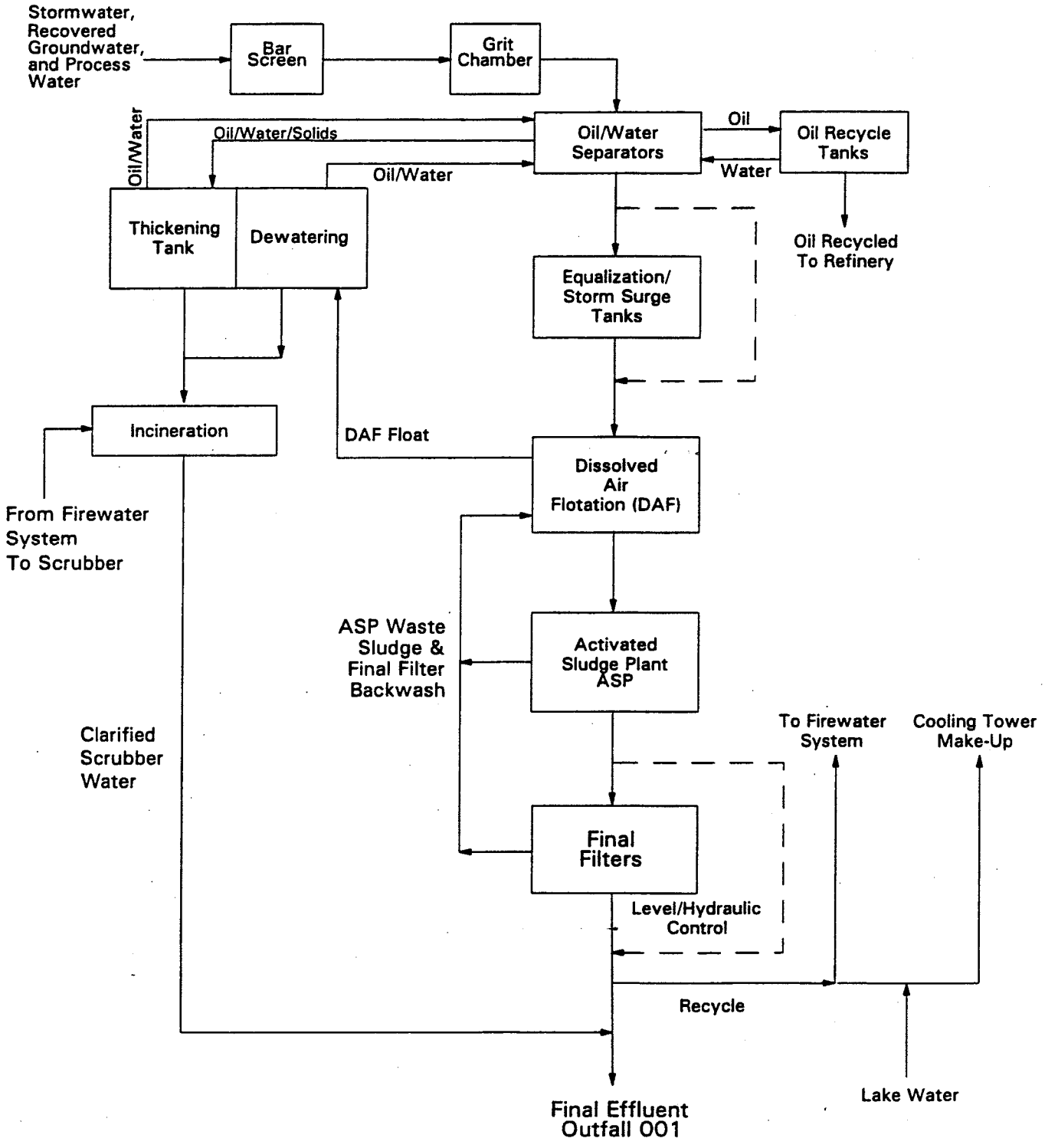

**FIGURE 1-1**
LOCATION MAP
WHITING, INDIANA

# FIGURE 1-2
# AREA MAP
# AMOCO OIL COMPANY - WHITING REFINERY




SOURCE: USGS 7.5 min. TOPOGRAPHIC MAPS LAKE CALUMET ILL. AND WHITING, IND. 1991

# FIGURE 1-3
# WASTEWATER TREATMENT PLANT - WATER FLOW DIAGRAM
# AMOCO OIL COMPANY - WHITING REFINERY



## SECTION 2

## OVERVIEW OF THE PROCESS FOR DERIVING LIMITS

### SUMMARY OF EVALUATION PROCESS

The proposed limits for the renewed NPDES permit are based upon an evaluation of:

- existing permit limits;
- technology-based permit limits; and,
- water quality-based effluent limits.

Permit limits are developed using each of the above permitting components. The most representative and valid of these limits are selected as the proposed permit limit for each parameter. The derivation of permit limits should also consider:

- historical performance;
- projected effluent quality;
- wasteload allocation for the receiving water; and,
- metals bioavailability.

A summary of the relationship between the different methods used to derive limits is provided in Figure 2-1.

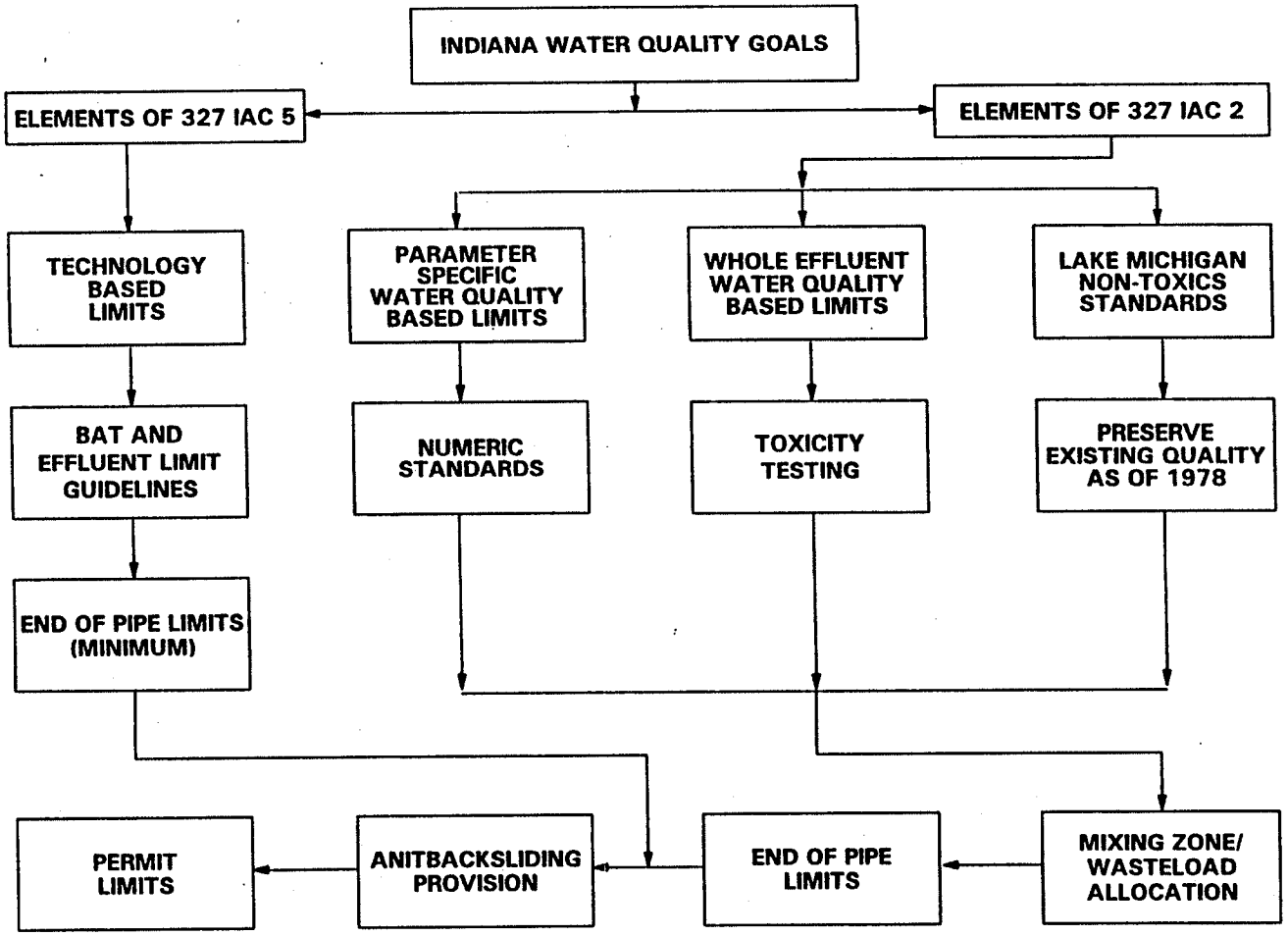
Due to antibacksliding provisions, as established by 327 IAC 5-2-10 (11), the existing permit limits are the starting point for deriving new permit limits. The renewed permit limits cannot be less stringent than existing limits.

The historical performance of the wastewater treatment plant (WWTP) can be evaluated by reviewing the Outfall 001 monthly Discharge Monitoring Reports (DMRs). These data, plus other representative and valid analytical data sets, are included in the effluent characterization data provided in Form 2C of the permit application.

upon the acid soluble metal fraction, whereas permit compliance is determined using total recoverable metal analyses.

The most representative and valid of these permit limits are selected as the proposed permit limit for each parameter. For a final check, this proposed permit limit value is compared to the lowest method detection limit (MDL) for the parameter to determine if the compliance evaluation level needs to be the limit of quantitation (LOQ).

# FIGURE 2-1. WATER QUALITY BASED TOXICS CONTROL




NOTE:
DISCHARGE LIMITS FOR EACH PARAMETER ARE BASED ON THE MOST VALID AND REPRESENTATIVE REQUIREMENT FOR THAT PARAMETER. TECHNOLOGY LIMITS MUST BE MET AS A MINIMUM.

## SECTION 3

## EXISTING PERMIT LIMITS

The existing permit limits were established in the permit that became effective on April 1, 1990. A summary of the existing effluent limitations for Outfall 001 is presented in Table 3-1. The existing permit limits are expressed as quantity or loading limits for most parameters, with further reporting requirements for the quality or concentration of the same parameters.

## TABLE 3–1. SUMMARY OF EXISTING PERMIT DISCHARGE LIMITATIONS FOR OUTFALL 001 (a)

| PARAMETER | QUANTITY OR LOADING | | | QUALITY OR CONCENTRATION (b) | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | UNITS | MONTHLY AVERAGE | DAILY MAXIMUM | UNITS | MEASUREMENT FREQUENCY | SAMPLE TYPE |
| Flow | Report | Report (c) | mgd | -- | -- | -- | Daily | Continuous |
| TBOD5 | 4,161 | 8,164 | lbs/day | Report | Report | mg/l | 5 X Weekly | 24 Hr. Comp. |
| TSS | 3,646 | 5,694 | lbs/day | Report | Report | mg/l | 5 X Weekly | 24 Hr. Comp. |
| COD | 30,323 | 58,427 | lbs/day | Report | Report | mg/l | 3 X Weekly | 24 Hr. Comp. |
| Oil and Grease | 1,368 | 2,600 | lbs/day | Report | Report | mg/l | 5 X Weekly | Grab (d) |
| Phenolics (4AAP) | 20.33 | 73.01 | lbs/day | Report | Report | mg/l | 3 X Weekly | 24 Hr. Comp. |
| Ammonia as N | 1,030 | 2,060 | lbs/day | Report | Report | mg/l | 5 X Weekly | 24 Hr. Comp. |
| Sulfide | 23.1 | 51.4 | lbs/day | Report | Report | mg/l | 1 X Weekly | 24 Hr. Comp. |
| Total Chromium (e) | 23.9 | 68.53 | lbs/day | Report | Report | mg/l | 1 X Weekly | 24 Hr. Comp. |
| Hex. Chromium (e) | 2.01 | 4.48 | lbs/day | Report | Report | mg/l | 1 X Weekly | 24 Hr. Comp. |
| Fecal Coliform (f) | -- | -- | -- | 200 | 400 | colonies/100ml | 5 X Weekly | Grab |
| Residual Chlorine (f) | -- | -- | -- | Report | 0.05 | mg/l | 5 X Weekly | Grab |
| pH | -- | -- | -- | -- | 6.5 – 9.0 | standard units | 3 X Weekly | Grab |

Notes:

(a) Permit effective from April 1, 1990 to February 28, 1995.

(b) Begin reporting no later than three months after the effective date of the permit.

(c) Report the daily maximum flow as the highest total daily flow for each monthly reporting period.

(d) Concentration value is the arithmetic mean of three individually analyzed samples collected at equally spaced time intervals during a 24–hour period.

(e) If the total chromium concentration is less than the limitations for hexavalent chromium concentration, then report the hexavalent chromium concentration as equal to the total chromium concentration.

(f) For April 1 through October 31, annually, and only when the refinery sanitary sewers are discharging to the WWTP.

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## SECTION 4

## HISTORICAL PERFORMANCE

Historical performance data are based upon several years of monitoring; therefore, the large number of samples provides a truly representative characterization of the effluent. This contrasts to some of the effluent characterization data in Form 2C where a limited number of samples are collected during stable operating periods over a period of several months.

Historical performance data for the parameters in the existing permit have been compiled in Table 4-1. This table reports the maximum daily maximum and maximum monthly average loads and concentrations reported on the monthly Discharge Monitoring Reports (DMRs). In accordance with the instructions for Form 2C of the permit application, the DMR data are for the period April 1991 to April 1994.

The historical performance data should be viewed in the context of the refinery production rate as expressed by the refinery crude oil throughput or feedstock. The technology-based limits for the existing permit were based on a crude oil throughput of 324,900 barrels per day. The refinery's maximum monthly average throughput is currently 410,000 barrels of crude oil per day.

TABLE 4-1. SUMMARY OF MAXIMUM HISTORICAL PERFORMANCE DATA (a)

| PARAMETERS | MAXIMUM DAILY MAXIMUM (b) | | MAXIMUM MONTHLY AVERAGE (b) | |
|---|---|---|---|---|
| | CONCENTRATION (mg/L) | LOAD (lbs/day) | CONCENTRATION (mg/L) | LOAD (lbs/day) |
| TBOD | 29 | 3,580 | 5.8 | 721 |
| TSS | 71 | 4,904 (c) | 24.6 | 2,059 |
| COD | 135 | 18,515 | 67.2 | 7,973 |
| Oil & Grease | 12.8 | 1,594 | 3.9 | 463 |
| Phenolics | 0.09 | 17.9 | 0.016 | 3.11 |
| NH3-N | 13.0 | 1,446 | 4.12 | 551 |
| Sulfide | 0.12 | 14.3 | 0.068 | 6.7 |
| Total Chromium | 0.03 | 5.3 | 0.015 | 2.4 |
| Hex Chromium | 0.007 | 1.23 | 0.003 | 0.58 |
| Total Selenium | 0.045 | 5.3 | No Permit Limit | No Permit Limit |
| Fecal Coliform | No Data (d) | No Permit Limit | No Data (d) | No Permit Limit |
| Total Residual Chlorine | No Data (d) | No Permit Limit | No Data (d) | No Permit Limit |
| pH | 8.1 standard units | No Permit Limit | 7.9 standard units | No Permit Limit |

NOTES:
(a) Source is the data reported in Form 2C of the permit application.
(b) Concentrations and loads are independent of each other, i.e., do not necessarily occur on the same date.
(c) Highest value (10,553 lbs/day on 08/31/93) is not included in the data set since it occurred due to successive rainfall events related to the extreme Midwest flooding of 1993.
(d) No data collected since sanitary wastewater did not discharge to the WWTP.

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## SECTION 5

## TECHNOLOGY-BASED PERMIT LIMITS

### DESCRIPTION OF TECHNOLOGY-BASED LIMITS

Technology-based permit limits for this effluent are developed in accordance with the EPA Effluent Guidelines and Standards for Petroleum and Petroleum Refining (40 CFR Part 419). The petroleum refining source category is divided into five subcategories. Based upon the process configuration of the Whiting Refinery, the technology-based effluent limitations for the Outfall 001 effluent are developed under Subpart D - Lube Subcategory.

40 CFR 419 Subpart D specifies three types of effluent limitations for existing point sources:

- BPT-Best Practicable Control Technology Currently Available (40 CFR 419.42);
- BAT-Best Available Technology Economically Achievable (40 CFR 419.43); and,
- BCT-Best Conventional Pollutant Control Technology (40 CFR 419.44).

A summary of the parameters applicable to these effluent limits is provided in Table 5-1.

The USEPA October 1982 *"Development Document for Effluent Limitations Guidelines New Source Performance Standards and Pretreatment Standards for the Petroleum Refining Point Source Category"* discusses the three types of technology-based limits:

> *"Best Available Control Technology Economically Achievable (BAT) is equivalent to the existing Best Practicable Technology Currently Available (BPT) level of control. BAT technology, which is the same as BPT, includes in-plant control and end-of-pipe treatment . . . BPT end-of-pipe treatment includes flow equalization, initial oil and solids removal (API separator or baffle plate separator), further oil and solids removal (clarifier or dissolved air flotation), biological treatment, and filtration or other final "polishing" steps. The effluent limitations for BAT are the same as those for BPT because the BAT flow model and subcategorization scheme are the same as those for BPT."*

developing BPT limits. For each parameter the BAT limits are determined using limits based upon the throughput for each of the five process groupings in 40 CFR 419 Appendix A:

- Crude Processes;
- Cracking and Coking Processes;
- Asphalt Processes;
- Lube Processes; and,
- Reforming and Alkylation Processes.

No size or process factors are applied. The calculation of the throughput for each of the process groups is shown in Table 5-4. The calculation of the BAT effluent limits for phenolic compounds [4AAP], total chromium, and hexavalent chromium is presented in Table 5-5.

The crude oil throughput or feedstock used in the above calculations is 410,000 barrels per day. This is the maximum monthly average production for the Whiting Refinery for the period 1991 to 1994.

TABLE 5-1. SUMMARY OF THE PARAMETERS REGULATED BY EACH TYPE OF TECHNOLOGY-BASED EFFLUENT LIMITATIONS FOR EXISTING SOURCES (a)

| PARAMETER | EFFLUENT LIMITATIONS TYPE | | |
|---|---|---|---|
| | BPT | BAT | BCT |
| BOD5 | X | | X |
| TSS | X | | X |
| COD | X | X | |
| Oil and Grease | X | | X |
| Ammonia as N | X | X | |
| Sulfide | X | X | |
| Phenolic Compounds [4AAP] | X | X | |
| Total Chromium | X | X | |
| Hexavalent Chromium | X | X | |
| pH | X | | X |

NOTES:
(a) 40 CFR Part 419 Subpart D

BPT – Best Practicable Control Technology Currently Available
BAT – Best Available Technology Economically Achievable
BCT – Best Conventional Pollutant Control Technology



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**TABLE 5-2. CALCULATION OF SIZE AND PROCESS FACTORS FOR BPT/BAT/BCT CALCULATIONS (40 CFR 419 SUBPART D – LUBE SUBCATEGORY)**

| PROCESS CATEGORY | PROCESSES INCLUDED | CAPACITY (1000 bbl per day) | CAPACITY RELATIVE TO THROUGHPUT | WEIGHTING FACTOR | PROCESSING CONFIGURATION |
|---|---|---|---|---|---|
| Crude | Atmospheric Crude Distillation | 410.0 | 1.000 | | |
| | Vacum Distillation | 212.0 | 0.517 | | |
| | Desalting Crude | 410.0 | 1.000 | | |
| | | 1032.0 | 2.517 | 1 | 2.517 |
| Cracking & Coking | Fluid Catalytic Cracking | 157.0 | 0.383 | | |
| | Delayed Coking | 28.6 | 0.070 | | |
| | | 185.6 | 0.453 | 6 | 2.718 |
| Asphalt | Asphalt Production | 60.0 | 0.146 | | |
| | | 60.0 | 0.146 | 12 | 1.752 |
| Lube | Hydrofinishing | 3.72 | 0.009 | | |
| | White Oil Manufacture | 1.08 | 0.003 | | |
| | Wax Fractionating | 20.7 | 0.050 | | |
| | MEK Dewaxing | 2.8 | 0.007 | | |
| | Wax Sweating | 7.2 | 0.018 | | |
| | NMP Extraction | 12.7 | 0.031 | | |
| | | 48.2 | 0.118 | 13 | 1.534 |
| Process Configuration Factor | | | | | 8.521 |

**(1) SIZE FACTOR**

Based on the table in 40 CFR 419.42 (b) (1), 419.43 (b) (1), or 419.44 (b) (1)

| 1,000 BBL OF FEEDSTOCK PER STREAM DAY | SIZE FACTOR |
|---|---|
| 200.0 or greater | 1.19 |

**(2) PROCESS FACTOR**

Based on the table in 40 CFR 419.42 (b) (2), 419.43 (b) (2), or 419.44 (b) (2)

| PROCESS CONFIGURATION FACTOR | SIZE FACTOR |
|---|---|
| 8.5 to 8.99 | 1.19 |

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TABLE 5–3. CALCULATION OF LIMITS BY BPT (a)

| PARAMETERS | TYPE OF EFFLUENT LIMITATION | DAILY MAXIMUM (lbs/1000) | MONTHLY AVERAGE (lbs/1000) | SIZE FACTOR | PROCESS FACTOR | 1000 BBL FEED | EFFLUENT LIMITATIONS | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | DAILY MAXIMUM (lbs/day) | MONTHLY AVERAGE (lbs/day) |
| BOD | BPT, BCT | 17.9 | 9.1 | 1.19 | 1.19 | 410 | 10,393 | 5,283 |
| TSS | BPT, BCT | 12.5 | 8.0 | 1.19 | 1.19 | 410 | 7,258 | 4,645 |
| COD | BPT, BAT | 127 | 66.0 | 1.19 | 1.19 | 410 | 73,736 | 38,320 |
| O & G | BPT, BCT | 5.7 | 3.0 | 1.19 | 1.19 | 410 | 3,309 | 1,742 |
| $NH_3$–N | BPT, BAT | 8.3 | 3.8 | 1.19 | 1.19 | 410 | 4,819 | 2,206 |
| Sulfide | BPT, BAT | 0.118 | 0.053 | 1.19 | 1.19 | 410 | 68.5 | 30.8 |
| Phenolics | BPT,BAT | 0.133 | 0.065 | 1.19 | 1.19 | 410 | 77.2 | 37.7 |
| Total Chrom | BPT, BAT | 0.273 | 0.160 | 1.19 | 1.19 | 410 | 158.5 | 92.9 |
| Hex Chrom | BPT, BAT | 0.024 | 0.011 | 1.19 | 1.19 | 410 | 13.93 | 6.39 |
| pH | BPT, BCT | (b) | (b) | (b) | (b) | (b) | 6.0 – 9.0 | 6.0 – 9.0 |

NOTES:
(a) Based on 40 CFR 419.42
(b) pH limit is within the range 6.0 to 9.0 s.u.

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TABLE 5–4. SUM OF PRODUCTS OF EACH EFFLUENT LIMITATION FACTOR (a)

| PROCESS CATEGORY | PROCESSES INCLUDED | MAXIMUM MONTHLY AVERAGE CAPACITY (1000 bbl / day) |
|---|---|---|
| Crude | Atmospheric Crude Distillation | 410.0 |
| | Vacuum Distillation | 212.0 |
| | Desalting Crude | 410.0 |
| | | 1032.0 |
| Cracking & Coking | Fluid Catalytic Cracking | 157.0 |
| | Delayed Coking | 28.6 |
| | | 185.6 |
| Asphalt | Asphalt Production | 60.0 |
| | | 60.0 |
| Lube | Hydrofinishing | 3.7 |
| | White Oil Manufacture | 1.1 |
| | Wax Fractionating | 20.7 |
| | MEK Dewaxing | 2.8 |
| | Wax Sweating | 7.2 |
| | NMP Extraction | 12.7 |
| | | 48.2 |
| Reforming & Alkylation | H2SO4 Alkylation | 31.0 |
| | Reforming | 90.0 |
| | Hydrotreating | 188.3 |
| | | 309.3 |

NOTES:
(a) Based on 419.43 (c) (i)

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TABLE 5–5. EFFLUENT LIMITS CALCULATED BY BAT (a)

| PARAMETER | PROCESSES INCLUDED | DAILY MAXIMUM (lbs/1000) | MONTHLY AVERAGE (lbs/1000) | 1000 BSD CAPACITY (lbs/1000) | EFFLUENT LIMITS | |
|---|---|---|---|---|---|---|
| | | | | | DAILY MAXIMUM (lbs/day) | MONTHLY AVERAGE (lbs/day) |
| – Phenolics Compounds | Crude | 0.013 | 0.003 | 1032.0 | 13.42 | 3.10 |
| | Cracking & Coking | 0.147 | 0.036 | 185.6 | 27.28 | 6.68 |
| | Asphalt | 0.079 | 0.019 | 60.0 | 4.74 | 1.14 |
| | Lube | 0.369 | 0.09 | 48.2 | 17.79 | 4.34 |
| | Reform & Alkylation | 0.132 | 0.032 | 309.3 | 40.83 | 9.90 |
| | | | | | 104.05 | 25.15 |
| – Total Chromium | Crude | 0.011 | 0.004 | 1032.0 | 11.35 | 4.13 |
| | Cracking & Coking | 0.119 | 0.041 | 185.6 | 22.09 | 7.61 |
| | Asphalt | 0.064 | 0.022 | 60.0 | 3.84 | 1.32 |
| | Lube | 0.299 | 0.104 | 48.2 | 14.41 | 5.01 |
| | Reform & Alkylation | 0.107 | 0.037 | 309.3 | 33.10 | 11.44 |
| | | | | | 84.79 | 29.51 |
| – Hexavalent Chromium | Crude | 0.0007 | 0.0003 | 1032.0 | 0.72 | 0.31 |
| | Cracking & Coking | 0.0076 | 0.0034 | 185.6 | 1.41 | 0.63 |
| | Asphalt | 0.0041 | 0.0019 | 60.0 | 0.25 | 0.11 |
| | Lube | 0.0192 | 0.0087 | 48.2 | 0.93 | 0.42 |
| | Reform & Alkylation | 0.0069 | 0.0031 | 309.3 | 2.13 | 0.96 |
| | | | | | 5.44 | 2.43 |

NOTES:
(a) Based on 40 CFR 419.43 (c) (i)

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TABLE 9–5. VERIFICATION OF NON–WQBEL VALUES (a)

| PARAMETER | CONC. UNITS | MONITORING DATA | | MIXING ZONE WASTELOAD ALLOCATION | | | | | | | | | PROPOSED PERMIT LIMITS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DAILY MAXIMUM | AVERAGE | 4–DAY CCC STANDARD | BACKGROUND CONC. | AAC STANDARD | ACUTE WLA | ACUTE DAILY MAXIMUM | ACUTE MONTHLY AVERAGE | CHRONIC WLA | CHRONIC DAILY MAXIMUM | CHRONIC MONTHLY AVERAGE | CONCENTRATION | | LOAD (lb/day) | |
| | | | | | | | | | | | | | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
| CHROMIUM (III) | ug/L | 30 | 10 | 278.5 | 10.86 | 2,314.2 | 126,694.6 | 126,694.6 | 54,478.7 | 20,886.8 | 34,233.4 | 14,746.1 | 34,233.4 | 14,746.1 | 6,424 | 2,767 |
| CHROMIUM (VI) | ug/L | 7 | 1 | 11 | 10 | 16 | 340.0 | 340.0 | 146.2 | 88.0 | 144.2 | 62.1 | 144.2 | 62.1 | 27 | 12 |
| PHENOLICS (d) | ug/L | 90 | 10 | 1.42 | 0.17 | | | | | 97.7 | 160.1 | 69.0 | 160.1 | 69.0 | 30 | 13 |
| AMMONIA (c) | mg/L | 13.0 | 0.6 | 0.23 | 0.01 | | | | | 17.2 | 28.1 | 12.1 | 28.1 | 12.1 | 5,281 | 2,275 |

NOTES:
(a) ZDIM Dispersion = 54 :1
TMZ Dispersion = 77 :1
(b) Flow = 22.5 MGD (IDEM Wasteload Allocation, September 1992)
(c) The summer 4–day CCC standard is presented since summer is the limiting season.
(d) Data for 1/91 to 3/94.

Column (1): Parameters where i) a load limit was calculated by a method other than the WQBEL process and, ii) numeric IWQS criteria exist.
Column (2): Units for each parameter.
Column (3): Daily maximum is the maximum for the monitoring database.
Column (4): Average is the average for the monitoring database.
Column (5): 4–day standards for 6j parameters = LM monthly average * 1.416 (as per IDEM WLA)
Column (6): Background concentration are 1992 IDEM WLA values except for phosphorous which is based on USEPA STORET data (1985 to 1992) for the Whiting Intake.
Column (7): No acute standards for 6j parameters (as per IDEM WLA)
Column (8): Acute WLA = AAC * (ZDIM Dispersion + 1) – BG * (ZDIM Dispersion)
Column (9): Acute daily maximum = acute WLA
Column (10): Acute monthly average = acute WLA * 0.43
Column (11): Chronic WLA = CCC * (TMZ Dispersion + 1) – BG * (TMZ Dispersion)
Column (12): Chronic daily maximum = chronic WLA * 1.639
Column (13): Chronic monthly average = chronic WLA * 0.706
Column (14): Concentration permit limits are equal to the lesser of acute daily maximum and chronic daily maximum.
Column (15): Concentration permit limits are equal to the lesser of acute monthly average and chronic monthly average.
Columns (16) and (17): Load permit limits = concentration * WLA flow * 8.34

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## TABLE 9–6. SUMMARY OF MARGINS OF SAFETY FOR PROPOSED MONTHLY AVERAGE PERMIT LIMITS OVER OTHER LESS STRINGENT LIMITS (g)

| PARAMETER | PROPOSED PERMIT LIMIT (a) | | EXISTING PERMIT LIMITS (b) | | BPT/BAT/BCT LIMITS (c) | | WQBEL PERMIT LIMITS (d) | |
|---|---|---|---|---|---|---|---|---|
| | LOAD | BASIS | LOAD | MARGIN OF SAFETY (%) | LOAD | MARGIN OF SAFETY (%) | LOAD | MARGIN OF SAFETY (%) |
| METALS | | | | | | | | |
| Total Chromium | 23.9 | Current Permit | 23.9 | (f) | 92.9 | 74% | Not Needed (e) | |
| Hex. Chromium | 2.01 | Current Permit | 2.01 | (f) | 6.39 | 69% | Not Needed (e) | |
| CONVENTIONALS | | | | | | | | |
| Ammonia as N | 1,030 | Current Permit | 1,030 | (f) | 2,206 | 53% | 1,783 | 42% |
| Total Phosphorus | 133 | WQBEL | | | | | 133 | (f) |
| Phenolics (4AAP) | 13 | WQBEL | 20.33 | 36% | 37.7 | 66% | 13 | (f) |
| Chlorides | 107,892 | WQBEL | | | | | 107,892 | (f) |
| Sulfates | 125,247 | WQBEL | | | | | 125,247 | (f) |
| TDS | 783,068 | WQBEL | | | | | 783,068 | (f) |
| TBOD5 | 4,161 | Current Permit | 4,161 | (f) | 5,283 | 21% | | |
| TSS | 3,646 | Current Permit | 3,646 | (f) | 4,645 | 22% | | |
| COD | 30,323 | Current Permit | 30,323 | (f) | 38,320 | 21% | | |
| Oil & Grease | 1,368 | Current Permit | 1,368 | (f) | 1,742 | 21% | | |
| Sulfide | 23.1 | Current Permit | 23.1 | (f) | 30.8 | 25% | | |

NOTES
(a) The most representative and valid limit is the draft permit limit.
(b) Permit effective from April 1, 1990 to February 28, 1995.
(c) In accordance with 40 CFR Part 419 Subpart D.
(d) In accordance with Technical Release OWM–1 Procedure for Developing Water Quality–Based NPDES Permit Limits for Toxic Pollutants, IDEM.
(e) Based upon USEPA procedures for determining whether a WQBEL is needed.
(f) Not applicable since this is the basis for the preliminary possible draft permit limt.
(g) Example for ammonia possible draft limit relative to a WQBEL permit limit:
Margin of safety = (1,783 – 1,030) / 1,783 * 100 = 42 %

WQBEL – Water Quality–Based Effluent Limit



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## TABLE 9-7. SUMMARY OF MARGINS OF SAFETY FOR PROPOSED DAILY MAXIMUM PERMIT LIMITS OVER OTHER LESS STRINGENT LIMITS (h)

| PARAMETER | PROPOSED PERMIT LIMIT (a) | | EXISTING PERMIT LIMITS (b) | | BPT/BAT/BCT PERMIT LIMITS (c) | | WQBEL PERMIT LIMITS (d) | |
|---|---|---|---|---|---|---|---|---|
| | LOAD (lb/d) | BASIS | LOAD (lb/d) | MARGIN OF SAFETY (%) | LOAD (lb/d) | MARGIN OF SAFETY (%) | LOAD (lb/d) | MARGIN OF SAFETY (%) |
| METALS | | | | | | | | |
| Total Chromium | 68.53 | Current Permit | 68.53 | (g) | 158.5 | 57% | Not Needed (e) | |
| Hex. Chromium | 4.48 | Current Permit | 4.48 | (g) | 13.93 | 68% | Not Needed (e) | |
| CONVENTIONALS | | | | | | | | |
| Ammonia as N | 2,060 | Current Permit | 2,060 | (g) | 4,819 | 57% | 4,128 | 50% |
| Total Phosphorus | 309 | WQBEL | | | | | 309 | (g) |
| Phenolics (4AAP) | 30 | WQBEL | 73.01 | 59% | 77.2 | 61% | 30 | (g) |
| Chlorides | 250,476 | WQBEL | | | | | 250,476 | (g) |
| Sulfates | 290,766 | WQBEL | | | | | 290,766 | (g) |
| TDS | 1,817,916 | WQBEL | | | | | 1,817,916 | (g) |
| TBOD5 | 8,164 | Current Permit | 8,164 | (g) | 10,393 | 21% | | |
| TSS | 5,694 | Current Permit | 5,694 | (g) | 7,258 | 22% | | |
| COD | 58,427 | Current Permit | 58,427 | (g) | 73,736 | 21% | | |
| Oil & Grease | 2,600 | Current Permit | 2,600 | (g) | 3,309 | 21% | | |
| Sulfide | 51.4 | Current Permit | 51.4 | (g) | 68.5 | 25% | | |

NOTES:
(a) The most representative and valid limit is the draft permit limit.
(b) Permit effective from April 1, 1990 to February 28, 1995.
(c) In accordance with 40 CFR Part 419 Subpart D.
(d) In accordance with Technical Release OWM-1 Procedure for Developing Water Quality-Based NPDES Permit Limits for Toxic Pollutants, IDEM.
(e) Based upon USEPA procedures for determining whether a WQBEL is needed.
(f) No limit required by any method used for developing permit limits.
(g) Not applicable since this is the basis for the preliminary possible draft permit limit.
(h) Example for ammonia possible draft limit relative to a WQBEL permit limit:
Margin of safety = (4,128 - 2,060) / 4,128 * 100 = 50 %

WQBEL - Water Quality-Based Effluent Limit

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**ATTACHMENT 1**

# TRAINING MANUAL FOR NPDES PERMIT WRITERS